

Chapter 7B: Update on RECOVER Implementation and Monitoring for the Comprehensive Everglades Restoration Plan

Agnes R. McLean, Kimberly Chuirazzi, John C. Ogden
and Patti Sime

SUMMARY

This chapter provides an update on Restoration Coordination and Verification (RECOVER) activities documented in Chapter 7B of the *2006 South Florida Environmental Report – Volume I* (SFER) (McLean et al., 2006). This update is presented in four categories: RECOVER-wide, Assessment, Evaluation, and Planning and Integration. The activities listed under the RECOVER-wide section fall under two or more mission areas.

RECOVER-wide activities are as follows:

- Defining Success
- Comprehensive Everglades Restoration Plan (CERP) Systemwide Performance Measures
- Adaptive Management Program
- RECOVER-Project Interaction Strategy
- Assessment activities are as follows:
 - Implementation of CERP Monitoring and Assessment Plan
 - 2006 Assessment Strategy for the Monitoring and Assessment Plan
- System Status Report

Evaluation activities are as follows:

- Performance measure consistency reviews and evaluations of alternative project plans
- Ecosystem Benefit Quantification Methodology

Planning and Integration activities are as follows:

- CERP A Refinement

Additional information on RECOVER is available on the CERP web site at www.evergladesplan.org/pm/recover/recover.cfm.

RECOVER-WIDE

DEFINING SUCCESS

The goals of the Comprehensive Everglades Restoration Plan (CERP) are to restore the greater Everglades ecosystem and to maintain or improve water supply and flood protection for human systems. While these general goals are clear at a broad scale, they are not particularly helpful as project implementation begins. Additionally, there may be a range of opinion about how these goals should be achieved (strategies) and a range of views about the qualities and/or characteristics of both the natural and human systems (outcomes) that must be achieved if the implementation of CERP is to be deemed a success.

To this end, a set of regional conceptual ecological models has been developed. This was published in the December 2005 issue of *Wetlands* (Barnes, 2005; Browder et al., 2005; Crigger et al., 2005; Davis et al., 2005a, 2005b; Duever, 2005; Havens and Gawlik 2005; Ogden, 2005; Ogden et al., 2005a, 2005b; Rudnick et al., 2005; Sime, 2005; VanArman et al., 2005). The models have been and continue to be utilized in the development of performance measures and restoration targets. RECOVER has begun a process to better integrate the set of systemwide performance measures; reconcile any inconsistencies, trade-offs, conflicts among them; refine and reaffirm the overall vision and definition of success; and incorporate a stronger contribution from the social sciences in this process that has been undertaken previously.

CERP SYSTEMWIDE PERFORMANCE MEASURES

Documentation

The systemwide performance measures of CERP are developed with the best available science and tools; however, the development and application of performance measures is a dynamic process that incorporates new scientific understandings and technical improvements. As our understanding of the ecosystem and the hypotheses that define ecologic relationships grows and new predictive and assessment tools are developed, the set of measures will be refined. Refinement of performance measures is part of CERP's Adaptive Management Strategy (RECOVER, 2006a). Therefore, this is a living document that will be continually updated as changes to the performance measures and their documentation sheets are approved by RECOVER's Evaluation and Assessment Teams. Sections discussing efforts related to application of performance measures will also be updated periodically to reflect their current status. The latest version of the CERP Systemwide Performance Measures document (RECOVER, 2006b), dated March 16, 2006, is available on the CERP web site at http://www.evergladesplan.org/pm/recover/eval_team_perf_measures.cfm.

Application

More work must be completed before the systemwide set of performance measures can be fully applied for prediction and assessment. In order to compare alternative plans during systemwide and regional evaluations, predictive tools such as computer simulation or regression models must be available to measure performance at a useful scale. The sensitivity of these performance measures and their inherent statistical uncertainties must also be determined to accurately compare the alternative plans. Tools must also be developed for assessing the effects of CERP implementation on the system; monitoring data alone does not provide an adequate assessment. Both the predictive and assessment tools must be consistent in their metrics, targets, and temporal and spatial scales for CERP to be adaptively managed. In addition, these tools must be consistent with the interim goals and targets (RECOVER, 2005).

The South Florida Water Management District (SFWMD or District) is in the process of prioritizing performance measures to focus the efforts of RECOVER on fully developing several performance measures and applications. A work plan is being developed to address the tasks needed to make the performance measures applicable to RECOVER's efforts of adaptively managing the systemwide aspects of CERP. The work plan will detail the tasks necessary to (1) resolve inconsistencies between the evaluation and assessment aspects of the measures and the interim goals (RECOVER, 2005); (2) develop and refine predictive tools; (3) develop assessment tools; (4) conduct sensitivity and uncertainty analysis; (5) develop feedback mechanisms between the assessment and evaluation applications; and (6) determine if the appropriate monitoring is being conducted to allow for accurate assessments and testing of predictive tools. The development and refinement of predictive tools (number 2 above) includes the migration from using the South Florida Water Management Model (SFWMM) as the main hydrologic simulation model to the Regional System Model (RSM). The RSM is expected to be fully functional by February 2008.

ADAPTIVE MANAGEMENT PROGRAM

RECOVER has the responsibility to coordinate the development and implementation of a systemwide Adaptive Management Program in support of CERP. RECOVER activities over the past year have focused on the completion of an Adaptive Management Strategy and the application of adaptive management for two restoration projects (the Decompartmentalization Adaptive Management Plan and Ten Mile Creek).

Adaptive Management Strategy

The Adaptive Management Strategy for CERP was completed in April 2006 (RECOVER, 2006a) and can be found in Appendix 7B-1 of this volume. The main elements of the strategy were laid out in the 2006 SFER. The strategy document explains why adaptive management is important to CERP and what benefits it can bring to the program before going into the more technical flow diagrams and their descriptions.

Decompartmentalization Adaptive Management Plan

The Decompartmentalization (Decomp) project involves reconnecting significant portions of the now-compartmentalized Everglades and restoring sheetflow, essential for restoring the ecological functioning of the Everglades ecosystem. Adaptive management is an essential strategy for implementing projects where there are comparatively large uncertainties and ranges of opinion regarding system responses and desired endpoints, respectively, as is the case with Decomp (Ogden, pers comm., May 2006). An example of active adaptive management is evident with the members of the project delivery team and RECOVER collaborating on an adaptive management initiative for Decomp during the last year. This initiative consisted of developing field-scale physical models and monitoring and data mining. This initiative is an example of active adaptive management.

Ten Mile Creek

Ten Mile Creek is the first of several reservoir/stormwater treatment facilities to be constructed as part of CERP. The project is designed to maximize environmental benefits to its downstream water body, the North Fork of the St. Lucie River. The adaptive management approach for this project is to optimize environmental operation protocols by testing and monitoring the ecological response of managed water deliveries to the downstream receiving waters. It is anticipated that lessons learned from Ten Mile Creek can be applied to future

operational plan development, especially those with coastal receiving water bodies. This effort is considered an example of passive adaptive management.

RECOVER-PROJECT INTERACTION STRATEGY

The Programmatic Regulations (DOD, 2003) require that RECOVER assist project teams to ensure that the project design is linked to the goals and purposes of CERP. More specifically, RECOVER strives to provide the following assistance to project teams:

- Assist project teams in understanding how project goals and objectives relate to overall CERP goals and objectives
- Assist project teams in implementing adaptive management strategies in project planning
- Provide information on the latest modeling assumptions for project planning
- Provide the scientific basis for project activities such as developing performance measures, developing monitoring plans, and determining project benefits
- Work with the project teams to determine which project alternative plan represents the best systemwide performance

RECOVER has developed a strategy for participating on projects to ensure that adequate assistance is provided. A diagram of this strategy along with explanatory text is provided in Appendix 7B-2 of this volume.

ASSESSMENT

CERP MONITORING AND ASSESSMENT PLAN

Table 7B-1 provides the status of monitoring components laid out in the CERP Monitoring and Assessment Plan: Part 1, Monitoring and Supporting Research (MAP) (RECOVER, 2004). **Table 7B-2** provides a similar list for key uncertainties and supporting research projects described in the MAP.

Table 7B-1. A list of Monitoring and Assessment Plan (MAP) components including MAP section and status. *(Note: To be updated in final report.)*

MAP Component	MAP Section	Status
GREATER EVERGLADES WETLANDS		
Fish Sampling Methods Testing in Forested Wetlands	3.1.3.10	Underway: SFWMD
Aquatic Fauna Regional Populations	3.1.3.10	Underway: SFWMD
Amphibian Communities as Restoration Indicators	3.1.3.10	To be implemented in FY2006: USACE
Dry Season Aquatic Fauna Concentrations	3.1.3.11	Underway: SFWMD
Wading Bird Foraging, Distribution, and Abundance	3.1.3.12	Underway (MOD Waters project)
Wading Bird Nesting Colony Location, Size, and Timing	3.1.3.12	Underway: USACE
Successful Snail Kite Nesting in Greater Everglades	3.1.3.13	To be implemented in FY2006: USACE
Wood Stork and Roseate Spoonbill Nesting	3.1.3.14	Underway: USACE

MAP Component	MAP Section	Status
American Alligator Distribution, Size, and Nesting	3.1.3.15	Underway: USACE
American Crocodile Juvenile Growth and Survival	3.1.3.16	Underway: USACE
Fish Sampling Methods Testing in Forested Wetlands	3.1.3.10	Underway: SFWMD
Interior Gradients of Flow	3.1.3.1	Planning underway
Regional Distribution of Soil Nutrients	3.1.3.2	Underway: SFWMD lead
Coastal Gradients: Salinity, Flow and Nutrients	3.1.3.3	Underway: USGS lead
Systemwide Vegetation Mapping	3.1.3.4	Contract negotiation underway
Landscape Pattern: Marl Prairie/Slough Gradients	3.1.3.5	Underway: USACE
Landscape Pattern: Ridge, Slough, Tree Islands	3.1.3.6	To be implemented in FY2006: SFWMD
Landscape Pattern: Tidal Creek Delineation	3.1.3.7	Complete: SFWMD
Mangrove Forest Soil Accretion	3.1.3.9	To be implemented in FY2006: USACE
Periphyton Mat Cover and Composition	3.1.3.8	Underway: SFWMD
SOUTHERN ESTUARIES		
Water Quality and Phytoplankton Monitoring Network	3.2.3.1	Underway: SFWMD (Non-RECOVER)
Salinity Monitoring Network	3.2.3.2	Underway: National Park Service, SFWMD, Miami-Dade Department of Environmental Resource Management (DERM)
South Florida Fish Habitat Assessment Network	3.2.3.4	Underway: SFWMD
Seagrass Fish and Invertebrate Assessment Network	3.2.3.5	Underway: NOAA/USACE
Shoreline Fish Community Visual Assessment	3.2.3.6	Underway: NOAA/USACE
Juvenile Spotted Seatrout Monitoring in Florida Bay	3.2.3.7	Underway: NOAA/USACE
Large-Scale Submerged Aquatic Vegetation Remote Sensing	3.2.3.4	Underway: SFWMD
NORTHERN ESTUARIES		
Salinity Monitoring Network	3.3.3.1	Underway
Water Quality and Phytoplankton Monitoring Network	3.3.3.2	Partially implemented; no phytoplankton monitoring currently
Submerged Aquatic Vegetation (SAV) Mapping from Aerial Photography	3.3.3.3	Underway in all but Lake Worth Lagoon
SAV Monitoring for Caloosahatchee Estuary	3.3.3.4	Underway
SAV Transects/Visual Surveys for St. Lucie Estuary/Indian River Lagoon, Lake Worth Lagoon, and Loxahatchee River Estuary	3.3.3.5	Underway in all estuaries except Lake Worth Lagoon
Oyster Monitoring Network	3.3.3.6	Underway
Juvenile Fish Community Monitoring Network (Caloosahatchee Estuary, St. Lucie Estuary and Indian River Lagoon)	3.3.3.7	Underway in Caloosahatchee Estuary; pilot project for St. Lucie Estuary/Indian River Lagoon with proposed FY2006 start
Benthic Macroinvertebrate Monitoring (St. Lucie Estuary, Loxahatchee River Estuary)	3.3.3.8	Underway in St. Lucie Estuary/Indian River Lagoon, planned FY2006 start in Loxahatchee Estuary

Table 7B-2. A list of key uncertainties and supporting research projects from the MAP including MAP section and status. *(Note: To be updated in final report.)*

Key Uncertainties and Supporting Research	MAP Section	Status
GREATER EVERGLADES WETLANDS		
Coastal Wetland and Bern Systems: Sea Level and CERP Influences	3.1.4.1	No funding proposed in FY2006
Tidal and Freshwater Creek Dynamics: Sea Level and CERP Influences	3.1.4.2	No funding proposed in FY2006
Productivity in Coastal Ecotones: Sea Level and CERP Influences	3.1.4.3	No funding proposed in FY2006
Ridge and Slough Landscape Pattern Sustainability	3.1.4.4	To be implemented in FY2006: SFWMD
Technology Development: NASA Vegetation Mapping	3.1.4.5	No funding proposed in FY2006
Crayfish Population Dynamics	3.1.4.6	Underway: SFWMD
Aquatic Refugia: Coastal Ecotone, Alligator Holes, and Solution Holes	3.1.4.7	To be implemented in FY2006: USACE
Ecological Effects of Canals and other Artificial Deep Water Habitats	3.1.4.8	To be implemented in FY2006: USACE
Synthesis of Wading Bird Surveys 1985–2001	3.1.4.9	Underway: SFWMD
Sub-lethal Effects of Contaminants of Wading Bird Reproductions	3.1.4.10	Underway: Florida Department of Environmental Protection (FDEP), USACE
SOUTHERN ESTUARIES		
Florida Bay Sediment Dynamics: Sea Level and CERP Influence	3.2.4.1	No proposed start date as of June 2005
Measurement of Submarine Groundwater Discharge to Biscayne Bay	3.2.4.2	No proposed start date as of June 2005
Biological Availability of Organic Nitrogen in Florida Bay	3.2.4.3	Underway: SFWMD
Present and Past Distribution of Oysters in South Florida Coastal Complex	3.2.4.4	Underway: Critical Ecosystem Studies Initiative
Factors Controlling Epibenthic Communities of Near-Shore Biscayne Bay	3.2.4.5	No proposed start date as of June 2005
Salinity Relationships of Epifaunal Species of Near-Shore Biscayne Bay	3.2.4.6	No proposed start date as of June 2005
Empirical Research of Epifaunal Species of Near-Shore Biscayne Bay	3.2.4.7	No proposed start date as of June 2005
Causal Factors of Fish Abnormalities in Biscayne Bay	3.2.4.8	No proposed start date as of June 2005
Bottlenose Dolphin Health Assessment in Biscayne Bay	3.2.4.9	No proposed start date as of June 2005
Manatee Abundance and Distribution Relative to Freshwater Inputs	3.2.4.10	No proposed start date as of June 2005
NORTHERN ESTUARIES		
Reconnaissance Study of Caloosahatchee	3.3.4.1	Complete
Fish Health and Pathology in the St. Lucie Estuary	3.3.4.2	Underway funded by state grants
Bottlenose Dolphin Health Assessment in St. Lucie Estuary	3.3.4.3	No proposed start date
Manatee Abundance and Distribution Relative to Changes in Freshwater Flows and Seagrass Distribution as a Result of Implementation of CERP Projects	3.3.4.4	No proposed start date

2006 Assessment Strategy for the Monitoring and Assessment Plan

In April 2006, the Assessment Team released a final draft of the *2006 Assessment Strategy for the Monitoring and Assessment Plan* for review (RECOVER, 2006c). This is an update on the *2005 Assessment Strategy for the Monitoring and Assessment Plan* (RECOVER, 2005b) described in the previous SFER report (McLean et al., 2006).

System Status Report

The Assessment Team is currently compiling the first annual system status report. This technical report presents the progress of CERP compared with the measured performance of CERP and the restoration targets of the performance measures. The report will be consulted and referenced by the U.S. Army Corps of Engineers and the SFWMD when preparing assessment reports as required by the Programmatic Regulations (DOD, 2003).

EVALUATION

PERFORMANCE MEASURE CONSISTENCY REVIEWS AND EVALUATIONS OF ALTERNATIVE PLANS

No performance measure consistency reviews have been conducted since publication of the 2006 SFER report. Instead, the Evaluation Team has concentrated on evaluating alternative plans for the following CERP projects: Biscayne Bay Coastal Wetlands and Lake Okeechobee Watershed. The team also evaluated an addendum to the Everglades Agricultural Area Reservoir Project. Currently, the team is assisting in evaluations of the CERP A Refinement effort discussed below. All Evaluation Team reviews and reports can be found on the CERP web site at http://www.evergladesplan.org/pm/recover/eval_team_reports.cfm.

ECOSYSTEM BENEFIT QUANTIFICATION METHODOLOGY

The Evaluation Team is developing an ecosystem benefit quantification methodology to assist with systemwide planning and alternative plan evaluation. A draft report should be available early in 2007.

PLANNING AND INTEGRATION

CERP A REFINEMENT

Evaluation of the hydrologic model results from the Initial CERP Update (October 2005) indicated that the performance of the Initial CERP Update model (termed CERP A) differed from that of the CERP model (termed D13R). These results were not surprising, given that a newer model version was used in the CERP A exercise, which had different inputs (e.g., topography and climate data), and had different computing capabilities. Additionally, during the development of CERP, more than 20 model simulations were performed and evaluated, each with the objective of iteratively maximizing the performance of CERP. This type of optimization was not performed with the Initial CERP Update.

RECOVER recommended to CERP managers that a follow-up effort to the Initial CERP Update be undertaken to improve the modeled performance of CERP A through operational optimization and some project modifications (for those projects far enough along in the planning process to have “tentatively selected plans”). The initiative for CERP A Refinement was approved and began in January 2006. The effort is anticipated to be completed in fall 2006.

LITERATURE CITED

189

190 Barnes, T.K. 2005. Caloosahatchee Estuary Conceptual Ecological Model. *Wetlands*
191 25(4):884-807.

192 Browder, J.A., R. Alleman, S. Markley, P. Ortner and P.A. Pitts. 2005. Biscayne Bay Conceptual
193 Ecological Model. *Wetlands* 25(4):854-869.

194 Crigger, D.K., G.A. Graves and D.L. Fike. 2005. Lake Worth Lagoon Conceptual Ecological
195 Model. *Wetlands* 25(4):943-954.

196 Davis, S.M., W.F. Loftus, E.E. Gaiser and A.E. Huffman. 2005a. Southern Marl Prairies
197 Conceptual Ecological Model. *Wetlands* 25(4):821-831.

198 Davis, S.M., D.L. Childers, J.J. Lorenz, H.R. Wanless and T.E. Hopkins. 2005b. A Conceptual
199 Model of Ecological Interactions in the Mangrove Estuaries of the Florida Everglades.
200 *Wetlands* 25(4):832-842.

201 DOD. 2003. Programmatic Regulations for the Comprehensive Everglades Restoration Plan;
202 Final Rule. Department of Defense, 33 CFR Part 385, Federal Register, November 12, 2003.

203 Duever, M.J. 2005. Big Cypress Regional Ecosystem Conceptual Ecological Model. *Wetlands*
204 25(4):843-853.

205 Havens, K.E. and D.E. Gawlik. 2005. Lake Okeechobee Conceptual Ecological Model. *Wetlands*
206 25(4):908-925.

207 McLean, A.R., K.J. Jacobs, J.C. Ogden and P. Sime. 2006. Chapter 7B: Update on RECOVER
208 Implementation and Monitoring for the Comprehensive Everglades Restoration Plan.
209 G. Redfield, ed. In: *2006 South Florida Environmental Report – Volume 1*. South Florida
210 Water Management District, West Palm Beach, FL.

211 Ogden, J.C. 2005. Everglades Ridge and Slough Conceptual Ecological Model. *Wetlands*
212 25(4):810-850.

213 Ogden, J.C., S.M. Davis, T.K. Barnes, K.J. Jacobs and J.H. Gentile. 2005a. Total System
214 Conceptual Ecological Model. *Wetlands* 25(4):955-979.

215 Ogden J.C., S.M. Davis, K.J. Jacobs, T. Barnes and H.E. Fling. 2005b. The Use of Conceptual
216 Ecological Models to Guide Ecosystem Restoration in South Florida. *Wetlands* 25(4):795-
217 809.

218 RECOVER. 2004. CERP Monitoring and Assessment Plan: Part 1, Monitoring and Supporting
219 Research. Restoration Coordination and Verification Team (RECOVER), c/o U.S. Army
220 Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water
221 Management District, West Palm Beach, FL.

222 RECOVER. 2005. The Recover Team's Recommendations for Interim Goals and Interim Targets
223 for the Comprehensive Everglades Restoration Plan. Restoration Coordination and
224 Verification Team (RECOVER), c/o U.S. Army Corps of Engineers, Jacksonville District,
225 Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

226 RECOVER. 2006c. Comprehensive Everglades Restoration Plan Adaptive Management Strategy.
227 Restoration Coordination and Verification Team (RECOVER), c/o U.S. Army Corps of

- 228 Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management
229 District, West Palm Beach, FL. April 2006.
- 230 RECOVER. 2006b. CERP Systemwide Performance Measures. Restoration Coordination and
231 Verification Team (RECOVER), c/o U.S. Army Corps of Engineers, Jacksonville District,
232 Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.
- 233 RECOVER. 2006c. 2006 Assessment Strategy for the Monitoring and Assessment Plan, Final
234 Draft. Integrative Assessment Team, Restoration Coordination and Verification Team
235 (RECOVER), c/o U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and
236 South Florida Water Management District, West Palm Beach, FL. April 2006.
- 237 Rudnick, D.T., P.B. Ortner, J.A. Browder and S.M. Davis. 2005. Florida Bay Conceptual
238 Ecological Model. *Wetlands* 25(4):870-883.
- 239 Sime, P. 2005. St. Lucie Estuary and Southern Indian River Lagoon Conceptual Ecological
240 Model. *Wetlands* 25(4):898-907.
- 241 VanArman, J., G.A. Graves and D.L. Fike. 2005. Loxahatchee Watershed Conceptual Ecological
242 Model. *Wetlands* 25(4):926-942.
- 243